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HARVARD  
UNIVERSITYA NEW SPECIES OF ORTHOMORPHA BOLLMAN FROM  
THAILAND OBSERVED IN MIGRATION, WITH  
TAXONOMIC NOTES ON THE GENUS (DIPLOPODA)

BY

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In a recent paper on the Paradoxosomatidae of Borneo (JEEKEL, 1963), I gave a taxonomic analysis of the species previously referred to the genera *Orthomorpha* Bollman, 1893, s. str., and *Pratinus* Attems, 1937. In this paper the genus *Pratinus* was restored to the original "*Prionopeltis*" concept of Pocock, and the misplaced species of *Pratinus* and the species of *Orthomorpha* s. str. were reallocated in some new genera and in fifteen preliminary groups, three of which were considered to constitute the genus *Orthomorpha* in a more proper sense.

Whereas the first of these three *Orthomorpha* groups contained 31 species, the second and third categories had only one species each. The reasons for isolating these two species were the somewhat aberrant gonopod characters, and particularly the apparent absence of a furrow demarcating the femoral from the postfemoral part of the acropodite. The validity of the two categories, however, was a little uncertain since this furrow might well have been overlooked by the author of the two species.

In a collection of unidentified Indo-Australian millipedes of the Copenhagen Museum, received on loan by courtesy of Prof. Dr. S. L. TUXEN, I found a new species of *Orthomorpha*, interesting because, although agreeing in general with the species of the first category, it completely lacks a demarcation between gonopod femur and postfemur. Thus it is now certain that such species really exist, which, naturally, enlightens on the systematic value of the said character.

A further point of interest is that the new species according to a statement on the locality label was collected during a mass migration. Some years ago (JEEKEL, 1954) I reported on the swarming of an unidentified species of the family Harpagophoridae in Malaya. For bibliographical references to this phenomenon I may refer to that paper and to a more recent note by DEMANGE (1960). The present case, in which the millipedes were observed while crawling by thousands in the sand of a dry river bed, appears to be the fourth reported from the Oriental region, and the first on record of an Oriental paradoxosomatid.

*Orthomorpha sericata* spec. nov. (Fig. 1—6)

**Material.** — Thailand: Wat Sum, Bandon River, 7.I.1935 (G. SEIDENFADEN leg., Mus. Copenhagen), holotype ♂, 7 paratype ♂, 7 paratype ♀ ("Krawl i Tusendins i Sandet i en tor Flodseng").

**Description.** — **Colour.** — Head and antennae dark castaneous, the lower part of the clypeus and the labrum pale brown, the tip of the antennae whitish. Collum, body segments, sternites and legs, and anal segment dark castaneous; the ventral side scarcely paler than the dorsal side. Lateral margins of the collum and the keels of the 2nd and 3rd segments pale yellowish. Lateral keels of the 4th and subsequent segments with only the posterior edges pale yellowish. End of tail pale.

**Width.** — **Holotype** ♂ : 2.9 mm. **Paratype** ♂ : 3.1, 3.0, 2.9 (3), 2.8 and 2.5 mm. **Paratype** ♀ : 3.5 (3), 3.4 (2), 3.3 (2) mm.

**Head and antennae.** — Labrum rather weakly emarginate, tridentate. Clypeus moderately convex, the lateral borders widely emarginate. Head plate rather dull, moderately setiferous in the clypeal part, more sparsely setiferous in the frontal part. Vertex with two pairs of hairs. Antennal sockets separated by one and a third times the diameter of a socket, or by about two thirds of the length of the 2nd antennal joint. Postantennal groove rather wide and shallow, the wall in front weakly prominent. Vertex rather convex, not demarcated from the frontal area. Vertigial sulcus rather weakly impressed, running downward to just between the antennal sockets. Antennae long, rather slender. The 2nd, 3rd, and 4th joints of subequal length, the 5th and 6th joints very slightly longer. Width of the 2nd to 6th joints very weakly increasing in that order. Pubescence rather dense in the proximal joints, becoming dense in the distal joints.

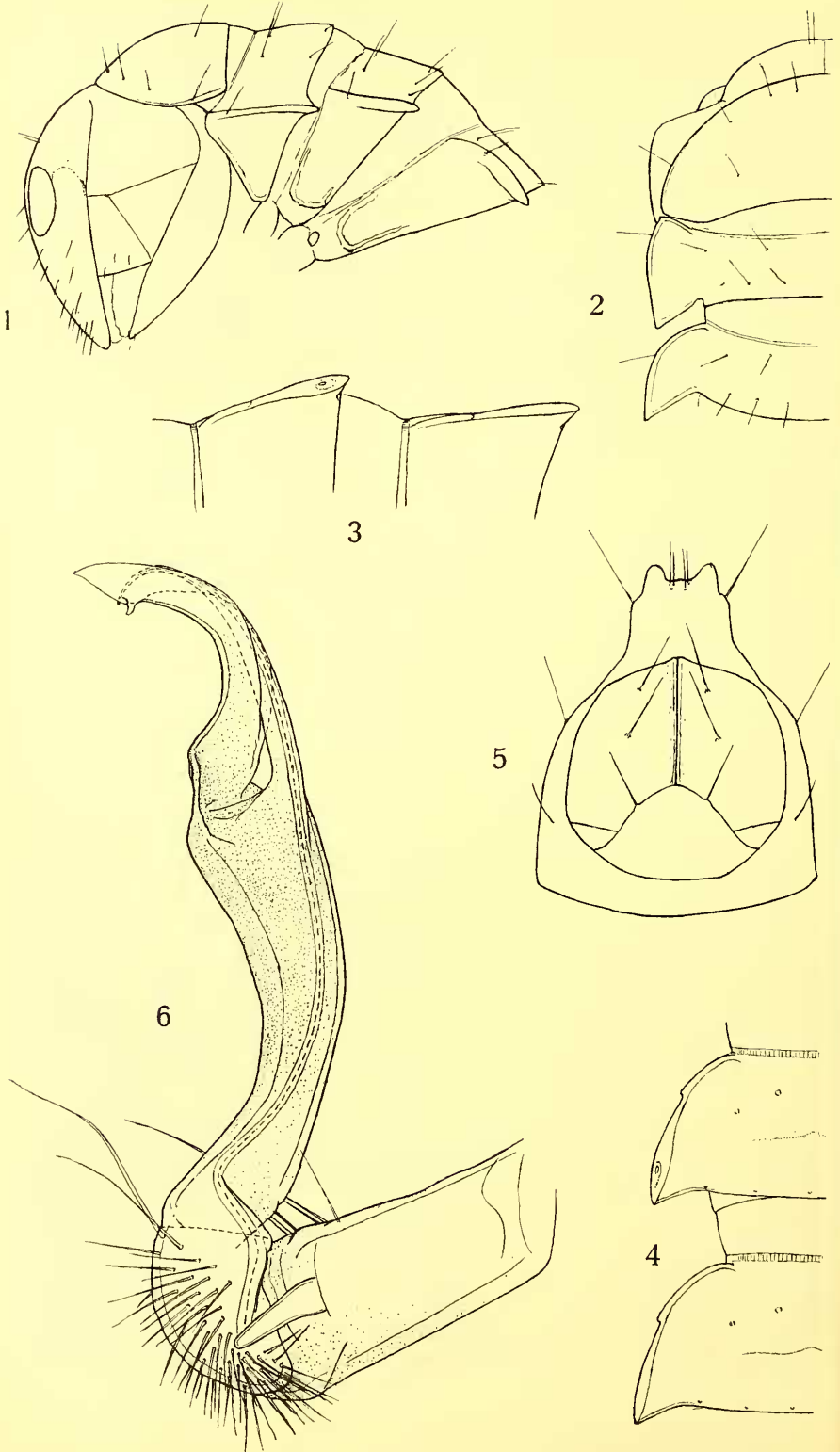
**Collum** (fig. 1—2). — A little narrower than the head. Semielliptical in dorsal outline. Anterior border widely rounded in the middle, a little more strongly rounded laterad. Posterior border widely and weakly emarginate in the middle, straight towards the lateral side, with a slight notch above the latero-posterior edge. Latero-posterior edge rather narrowly and asymmetrically rounded. Surface transversely moderately convex, rather dull, with three transverse rows of rather long hairs, which, however, are usually partly rubbed off. Marginal rim narrow and laterally weakly defined, disappearing towards the middle of the anterior border.

**Body segments.** — Moderately constricted. Prosomites very dull, silky. Waist rather narrow, distinctly demarcated from the prosomites only, dorsally finely longitudinally ribbed, without sculpture below the level of the lateral keels. Metatergites of anterior segments rather dull, from the 4th or 5th segment onwards very dull, silky. Transverse furrow rather weakly impressed, without sculpture, present from the 4th or 5th segment to the 17th or the 18th segment. In front of the transverse furrow a transverse row of four minute setiferous granules, the lateral pair smallest. Along the posterior border a row of about six minute granules, of which the lateral pair is the most distinct. In most segments these granules are hairless, but in a few anterior and posterior segments they are, at least in part, setiferous. Sides of metasomites rather dull, not silky, finely granulate in the 2nd to 5th segments, smooth or a little rugulose from the 6th segment onwards. Pleural keels of the 2nd, 3rd, and 4th segments represented by finely granular ridges. In the 2nd and 3rd segments these ridges are curving upward anteriorly, paralleling the waist up to about halfway the lateral keels. In the 3rd and 4th segments they end caudally in an obtusely triangular lappet just before the posterior margin. Dorsad of this lappet there is a ridge parallel to the posterior margin up to just below the level of the lateral keels. From the 5th segment onwards the pleural

keels are represented only by the triangular lappet, which is generally pointed, directed caudad and laterad, and does not project behind the posterior margin of the segments. In the 17th segment the lappet becomes much smaller, and in the 18th it has completely disappeared. The fine ridge parallel to the posterior margin of the segments is also present in the 5th segment, but it soon disappears in subsequent segments.

Lateral keels (fig. 1—4). — The 2nd segment wider than the collum. Anterior border of the keels thrust forward, weakly rounded, the latero-anterior edge obtusely angular, often with a small tooth. Lateral border widely and weakly rounded. Posterior border almost straight, rounded near the base only. Latero-posterior edge acute or almost rectangular, pointed, projecting rather strongly beyond the caudal margin of the metasomite. Keels of the 2nd segment on a horizontal level or faintly sloping downward, their level distinctly below that of the keels of the 3rd segment. Marginal rim narrow. Premarginal furrow indistinct along the posterior and caudo-lateral borders, much more distinct in the anterior half of the keel. 3rd and 4th segments of subequal width, a little narrower than the 2nd, and distinctly narrower than the 5th segment. The keels anteriorly scarcely shouldered at the base, rather widely rounded in the anterior half, almost straight in the posterior half. Posterior edges acute, particularly in the 3rd segment. Keels of the 3rd segment horizontal, those of the 4th segment turned a little upward. Posterior border straight. Marginal rim slightly incrassate in the posterior half of the keels, but faintly demarcated. Latero-anterior and posterior borders with a narrow but more distinctly demarcated rim. Keels from the 5th segment onwards anteriorly and laterally widely rounded, generally a little shouldered at the base. Caudal edges acute and projecting distinctly behind the posterior margin of the segments, in particular in the segments of the posterior third of the body. From about the 15th segment onwards the caudal edges are prolonged into a fine, somewhat incurved sharp point. Keels of the 5th to 18th segments turned upwards and projecting a little above the middorsal level of the corresponding tergites. Dorsal premarginal furrow of keels running from the waist to near the posterior edge; a fine marginal rim also along the posterior border. Marginal rim widening in the second half of the keels, especially in the poriferous keels. In the anterior half of the keels there is a more or less well developed lateral tooth, which is also indicated in the 4th segment. Ventrally the marginal rims are demarcated also by a furrow, at least in the posterior half of the keels and in particular in the poriferous segments. Ozopores situated latero-dorsally in a slight oval excavation of the marginal rims.

Sternites and legs. — Sternites of middle segments about as long as wide; pubescence moderately dense, the hairs rather long. Transverse furrow moderately impressed. Longitudinal furrow absent; instead, the sternites are widely transversely concave. Sternite of the 5th segment with a pair of strong, acute, deeply separated cones pointing downward between the anterior legs, otherwise normal. Sternite of the 6th segment deeply concave, the middle between the posterior legs not raised above the ventral level of the metasomal ring. Sternite of the 8th and subsequent segments without modifications. Legs long and rather slender. Length of joints:  $6 = 3 > 5 > 4 > 2 > 1$ , the 5th joint about three fifths of the 6th. Prefemora





distinctly incrassate. Pubescence moderately dense, only the tarsus somewhat more densely setiferous. Tarsal and distal tibial brushes present in the first two pairs of legs, thinning out in the 3rd and 4th pairs and absent from the 5th pair onwards. All legs without modifications, the posterior pairs not elongated.

Anal segment (fig. 5). — Tail of moderate length, rather broad. Sides of tail basally rather strongly converging, then almost parallel up to the lateral setiferous tubercles. The end with a pair of rather strongly developed rounded cones pointing straight backward. Valves rugulose, the marginal rims narrow and low. Setae placed on minute tubercles. Scale rather broad, parabolically rounded; setiferous tubercles small, projecting very slightly beyond the margin.

Gonopods (fig. 6). — Coxa straight and slender. Prefemur short. Femur laterally distinctly demarcated from the prefemur, but no trace of a demarcation between femur and postfemur. Course of spermal channel as in the other species of the genus. Tibiotarsus a simple solenophore; the lamina lateralis and lamina medialis almost equally developed. At the posterior side of the base of the tibiotarsus a rounded lobe projecting mesad. Lamina medialis apically produced into a triangular lamella; before the end a minute uncate lobe.

Female. — In addition to the usual sexual characters, the female specimens have a slightly more robust habit as a result of the relatively weaker development of the lateral keels. Antennae a little shorter; the sockets separated by almost three quarters of the 2nd antennal joint. Dorsum a little more convex; the lateral keels projecting above the middorsal level only in the 17th and 18th, or 18th segment. Sternites of middle segments only slightly broader than long. Legs comparatively a little shorter though scarcely more slender; the 6th joint a little shorter than the 3rd; tarsal brushes absent.

Location of type material. — The holotype ♂ and five paratypes of either sex in the Copenhagen Museum. Two male and two female paratypes in the Zoological Museum, Amsterdam.

The description of this new species invites a discussion on the interrelationship of the species of *Orthomorpha* in the present concept. Unfortunately, however, a number of species, although undoubtedly belonging to the genus, cannot yet be included in this discussion. These are *O. acutangulus* (Newport), *O. bipunctata* (Sinclair), *O. consocius* Chamberlin, *O. fuscocollaris* Pocock, *O. montana* (Chamberlin), *O. oatesii* Pocock, and *O. paviei* Brölemann, all of which first require a closer re-examination of the gonopods. On the other hand I am able to subjoin here some drawings of the hitherto unknown gonopod apices of three species. I gratefully acknowledge my obligation to Dr. R. L. HOFFMAN for generously allowing publication of some sketches of the gonopods of *Orthomorpha monticola* Pocock and *Orthomorpha insularis* Pocock made after paratypes of these species

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Fig. 1—6. *Orthomorpha sericata* spec. nov. — 1, left side of the head and the four anterior segments of a paratype ♂, lateral aspect. — 2, left side of the head and the first three segments of the same paratype ♂, dorsal aspect. — 3, left side of the 10th and 11th segments of the same paratype ♂, lateral aspect. — 4, the same, dorsal aspect. — 5, anal segment of the same paratype ♂, ventral aspect. — 6, right gonopod of the holotype ♂, mesal aspect

in the British Museum (Natural History). The drawing of the gonopod apex of *Orthomorpha conspicua* (Pocock) was made after the paratype in the Zoological Museum at Amsterdam.

### Group A

A majority of the species of *Orthomorpha* have the apex of the gonopods typically shaped (fig. 7—9). In profile the lamina medialis ends in three minute lappets: two more or less triangular, sometimes somewhat more elongate lappets, separated by an emargination or slit, and a slightly more proximal subquadrate or tongue-shaped lappet. Considering the distributional area of the species of this group, which ranges from Indochina to Lombok and practically coincides with the natural area of the genus, this structure is surprisingly constant. Specific differences mainly affect the relative proportions of the lappets and other parts of the gonopods.

Notwithstanding the obvious homogeneity of the group some minor categories already become manifest. First there is the *weberi*-group which has besides *O. weberi* (Pocock, 1894), also *O. conspicua* (Pocock, 1894), *O. flaviventer* (Attems, 1898), and *O. francisca* Attems, 1930. The gonopod apex has the middle lobe smaller than the distal lobe, and both are comparatively short and are separated by a rather wide emargination (fig. 9). Sternite of the 5th segment of the male with a pair of cones between the anterior legs. The marginal calluses of the lateral keels are well developed, somewhat incassate, not widening conspicu-

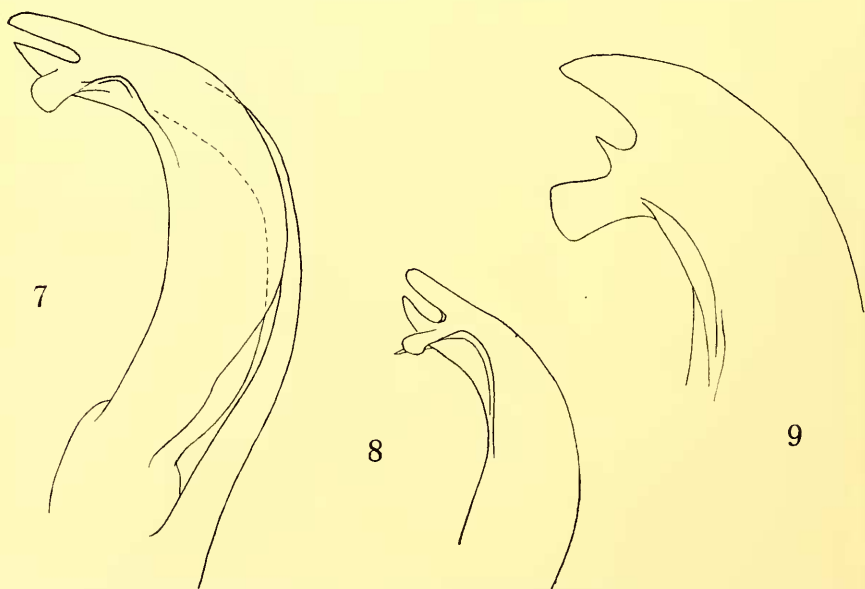


Fig. 7. *Orthomorpha monticola* Pocock, tibiotarsus of the right gonopod of a paratype ♂, mesal aspect. — Fig. 8. *Orthomorpha insularis* Pocock, apex of right gonopod of a paratype ♂, mesal aspect. — Fig. 9. *Orthomorpha conspicua* (Pocock), apex of right gonopod of the paratype ♂, mesal aspect

ously in the area of the pores. According to the non-gonopod characters the type-species of *Orthomorpha*, *O. beaumontii* (Le Guillou), belongs to this group.

A closely related group is the *hydrobiologica*-group, with *O. hydrobiologica* Attems, 1930, *O. unicolor* Attems, 1930, *O. spinala* Attems, 1932, and *O. cambodjana* (Attems, 1953); this group has the gonopod apex and the lateral keels as in the *weberi*-group but lacks sternal processes in the 5th segment of the male.

The *karschii*-group comprises *O. karschii* (Pocock, 1889), *O. insularis* Pocock, 1895, *O. monticola* Pocock, 1895, and *O. rotundicollis* (Attems, 1937). In the species of this group the gonopod apex has the distal and middle lobes of sub-equal size, somewhat elongate and separated by a narrow slit (fig. 7—8). Sternite of the 5th segment of the male with a pair of cones between the anterior legs. The marginal calluses of the lateral keels are very strongly developed, and have the tendency to comprise the larger part of the dorsal surface of the keels. The colour of the body segments is typical in that the larger part of the metatergites is flavous contrasting strongly with the dark colour of the rest of the body. To this group may belong also *O. gestri* Pocock, 1895, *O. clivicola* Pocock, 1895, *O. palonensis* Pocock, 1895, and *O. intercedens* Attems, 1937.

There remain a few more or less isolated species which have the gonopod apex as in the *weberi*, *hydrobiologica* and *karschii*-groups, yet are not clearly referable to any of these. Probably they will prove to represent other species-groups when the areas in which they occur, Burma and Indochina, are more thoroughly explored. These species are *O. glandulosa* (Attems, 1937), *O. tuberculata* (Attems, 1937), and *O. scabra* nom. nov.\*)

### Group B

A second category of species agrees entirely in the gonopod structure with the species of group A, except that the apex of the gonopods lacks the characteristic profile. Besides the proximal tongue-shaped lappet, the lamina medialis has only a single terminal lappet here, a condition probably the result of a complete reduction of the middle lobe.

Contrary to group A, this is not a homogeneous category, and the three species which belong here, *O. tenuipes* (Attems, 1898), *O. zehntneri* Carl, 1902, and *O. arboricola* Attems, 1937, are rather widely different in non-gonopod characters. Probably *tenuipes* is closely related to the *weberi* group, but this does not hold for *zehntneri* and *arboricola*.

### Group C

*O. coarctata* (De Saussure, 1860), the well-known tropical ubiquist, in general gonopod structure fully agrees with the species of the previous groups, but the gonopod apex is still different here. It apparently lacks the tongue-shaped lappet which is present in the species of groups A and B, and simply has a single rounded terminal lappet, without other lobes.

\*) *Orthomorpha scabra* nom. nov. for *Pratinus granosus* Attems, 1953, Mém. Mus. nat. Hist. nat., n.s., A, vol. 5, p. 166, not *Orthomorpha granosa* Attems, 1913, Denkschr. k. Akad. Wiss. math.-naturw. Kl., vol. 89, p. 683.

## Group D

In my Borneo paper I referred *O. butteli* (Carl, 1922) and *O. bipulvillata* Carl, 1902, to the categories II and III, respectively, to emphasize their isolated position as against each other and the majority of species of *Orthomorpha*. The absence of a demarcation between the gonopod femur and postfemur in these two species is still to be verified. That species of *Orthomorpha* exist in which this demarcation has disappeared is demonstrated conclusively in the presently described species. However, *sericata* is quite disjunct from *butteli* and *bipulvillata* and its discovery does not throw any new light on the position of the latter two species. If the demarcation eventually proves to be really absent in *butteli* and *bipulvillata*, these two species and *sericata* form a polyphyletic group. Consequently, the character, although important, should be used with great caution in the delimitation of genera.

The emended concept of *Orthomorpha* has rendered useless the previous keys to the species of this genus. Therefore, a new key is given here, which is meant as a base to be extended with the increase of our knowledge of the proper characters of the species. Besides the seven insufficiently known species mentioned already, I had to exclude from this key for the time being also *O. beaumontii* (Le Guillou), *O. clivicola* Pocock, *O. gestri* Pocock, *O. intercedens* Attems, and *O. palonensis* Pocock.

Key to the species of *Orthomorpha* based on male characters

1. Gonopod telopodite without distinct demarcation between the femoral and postfemoral parts . . . . . 2
- Gonopod telopodite with a distinct demarcation between the femoral and postfemoral parts, represented by a sharp oblique furrow on the lateral side . . . 4
2. Width 4.0—4.5 mm. Collum laterally rounded. Lateral keels without sharply defined marginal calluses. Pleural keels in segments 2 to 4 only. Sternites of the 4th and 5th segments each with a process. Ventral side of legs with dense pubescence; the prefemur, tibia and tarsus with brushes in nearly all legs . . . . . *O. bipulvillata* Carl, 1902
- Width up to 3.1 mm. Collum with a latero-posterior edge. Lateral keels with well defined marginal calluses. Sternite of the 4th segment without process. Prefemur of the legs without brush . . . . . 3
3. Width 2.2—2.3 mm. Metatergites coriaceous, but without granules. Pleural keels present only in the 2nd and 3rd segments. Tarsal brushes present up to about the 10th pair of legs. Sternite of the 5th segment with a single process between the anterior legs . . . . . *O. butteli* (Carl, 1922)
- Width 2.5—3.1 mm. Metatergites dull, silky, with two transverse rows of minute granules. Tarsal brushes absent from the 5th leg onwards. Sternite of the 5th segment with a pair of processes between the anterior legs . . . . . *O. sericata* spec. nov.
4. Apex of tibiotarsus with one or two lobes . . . . . 5



- Apex of tibiotarsus with three lobes of characteristic shape: two more or less triangular lobes, separated by an emargination of variable width and depth, and a slightly more proximal rectangular or tongue-shaped lappet (fig. 7—9) . . . . . 8
- 5. Width less than 3 mm . . . . . 6
- Width more than 3 mm . . . . . 7
- 6. Width 2.8 mm. Colour of metatergites dark brown with the lateral margins and the posterior edges of the keels reddish brown. Metatergites with two transverse rows of setiferous granules. Marginal calluses of keels thin. Sternite of the 5th segment with a single, distally incised process between the anterior legs. Legs with thick tarsal brushes . . . . . *O. zehntneri* Carl, 1902
- Width 1.9—2.5 mm. Colour of metatergites dark brown, the lateral keels bright yellow. Metatergites without rows of setiferous granules. Marginal calluses of keels thick. Sternite of the 5th segment without process. Legs without thick brushes . . . . . *O. coarctata* (De Saussure, 1860)  
+ f. *gigas* Attems, 1927
- 7. Width 3.6 mm. Colour of metatergites brown, the keels not paler. Tergites with two transverse rows of 4 and 6 large flat tubercles. Sternite of the 5th segment with a single process between the anterior legs . . . . .  
. . . . . *O. arboricola* (Attems, 1937)
- Width 4.0 mm. Colour of metatergites brown, the lateral keels bright yellow. Tergites with a row of 6 granules along the posterior border. Sternite of the 5th segment with a pair of processes between the anterior legs . . . . .  
. . . . . *O. tenuipes* (Attems, 1898)
- 8. Sternite of the 5th segment without process . . . . . 9
- Sternite of the 5th segment with a single process or with a pair of processes between the anterior legs . . . . . 10
- 9. Body segments including the lateral keels and the tail brown . . . . .  
. . . . . *O. unicolor* Attems, 1930
- Body segments brown, the lateral keels and the tail bright yellow . . . . .  
. . . . . *O. hydrobiologica* Attems, 1930  
*O. spinata* Attems, 1932  
*O. cambodjana* (Attems, 1953)
- 10. Sternite of the 5th segment with a single large process between the anterior legs. Colour brown, the keels and the tail yellow. Metatergites with two transverse rows of 4 and 4 to 6 tubercles. Pleural keels present only in the pregonopodial segments, ending in a small tooth. Width 5.0 mm . . . . .  
. . . . . *O. glandulosa* (Attems, 1937)
- Sternite of the 5th segment with a pair of processes between the anterior legs . . . . . 11
- 11. Metatergites densely granulate and with two transverse rows of 4 and 6 large flat and smooth tubercles. Colour of metatergites dark brown, the lateral keels paler, yellowish brown. Pleural keels without produced posterior edge. Width 4.6 mm . . . . . *O. scabra* nom. nov.
- Metatergites smooth or coriaceous, with or without tubercles, but not granulate . . . . . 12

12. Collum laterally elliptically rounded. Anterior portion of metatergites brown, the posterior part yellow. Pleural keels produced into a small tooth up to the 7th segment. Legs ventrally with rather dense and long pubescence, tarsal brushes present. Width 4.0 mm . . . . . *O. rotundicollis* (Attems, 1937)
- Collum with a distinct latero-posterior edge . . . . . 13
13. Metatergites with two rows of tubercles: an anterior row of 4 small, and a posterior row of 6 to 8 coarse, flat tubercles. Colour brown, the lateral keels paler. Pleural keels ending in a tooth up to the 7th or 8th segment. Legs without brushes. Width 4.0 mm . . . . . *O. tuberculata* (Attems, 1937)
- Metatergites without tubercles or with weakly developed granules . . 14
14. Collum entirely yellowish or yellowish in the posterior half only. Metatergites entirely yellowish, except for a narrow zone along the waist which has the same dark colour as the prosomites . . . . . 15
- Collum and metatergites dark brown, the lateral keels paler or bright yellow . . . . . 16
15. Collum yellow all over. Marginal calluses of the lateral keels comprising about half of the dorsal area of the keels. Width about 5.0 mm . . . . .
- . . . . . *O. karschii* (Pocock, 1889)
- Collum dark brown in front. Marginal calluses of the lateral keels comprising almost the entire dorsal area of the keels. Width 5.2—6.0 mm . . . . .
- . . . . . *O. insularis* Pocock, 1895
- . . . . . *O. monticola* Pocock, 1895
16. Colour of metatergites dark brown, the lateral keels somewhat paler reddish brown. Anterior segments with weakly developed pleural keels. Width 5.0 mm . . . . . *O. flaviventer* (Attems, 1898)
- Colour of metatergites dark brown, the lateral keels bright yellow. Pleural keels distinct in most segments . . . . . 17
17. Width 3.7 mm . . . . . *O. conspicua* (Pocock, 1894)
- Width 4.7 mm . . . . . *O. weberi* (Pocock, 1894)
- . . . . . *O. francisca* Attems, 1930

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